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Chewing Gum, Acetaminophen, and Green Tea Effect in Reducing Pain After Orthodontic Appliance Placement

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ABSTRACT

Background: Pain is a common problem encountered after fixed orthodontic appliance placement. Pain from orthodontic treatment can come from ischemia, inflammation, and edema in the periodontal ligaments that were depressed. **Objectives:** To determine whether there are differences in the pain reduction associated with chewing gum, taking acetaminophen, and gargling green tea after fixed orthodontic appliance placement. **Methods:** This study is a quasi-experiment with a controlled randomized post-treatment approach using 40 subjects. The subjects were consecutively selected and then randomly assigned into four equal groups: a group assigned to chewing gum, a group assigned to take acetaminophen, a group assigned to gargle green tea, and a control group. The level of pain was measured using a Visual Analogue Scale (VAS). A one-way ANOVA test was used to analyse differences between the groups. **Results:** The VAS scores of the chewing gum and acetaminophen groups were lower than the green tea and control groups. At 24 hours after fixed orthodontic appliance placement, only the chewing gum group reported a decrease in the amount of pain experienced. Overall, the chewing gum group reported the lowest pain scores compared to other groups. However, there was no overall statistically significant difference between the chewing gum and acetaminophen group ($p>0.05$). Additionally, there was no statistically significant difference in the amount of pain reduction experienced by the green tea group and the control group ($p>0.05$). There was a significant difference in the amount of pain reduction reported between the chewing gum or acetaminophen groups and the green tea group ($p<0.05$). **Conclusion:** There was no significant difference between chewing gum and taking acetaminophen in the amount of pain reduction experienced after fixed orthodontic appliance placement, but gargling with green tea was found to be significantly less effective in reducing pain. Because it has fewer side effects, chewing gum may be a more preferable alternative to taking acetaminophen to reduce pain after fixed orthodontic appliance placement.

Keywords : acetaminophen, chewing gum, green tea, orthodontic, pain

Background

Pain is a common problem in dentistry, including in orthodontic treatment. Approximately 90-95% of orthodontic patients experience some degree of pain. It is the most disturbing factor in treatment and is the main reason patients stop orthodontic treatment.[1] Orthodontic pain is caused by inflammation and ischemia[2] created by orthodontic force on the periodontal ligament. Where the orthodontic treatment creates a mechanical load, periodontal tissue will become inflamed and will create prostaglandins, a hormon-like substance which can cause pain. Prostaglandins are synthesized from hydronic acidic acid by cyclooxygenase (COX).[3]

Pain in the early stages of fixed orthodontic appliance placement will likely occur and reach its peak within 24 hours after placement and will begin to decline by the third day. There is a potential difference in pain perception across age groups. A narrower age range could allow a more accurate assessment of the roles other factors play in pain reduction. Adolescents, especially those aged 13-16 years, tend to experience higher levels of pain compared to pre-adolescents and adults.[4,5]

Acetaminophen as an analgesic drug is commonly used to manage the pain, but it can have adverse effects, such as hepatotoxicity. Acetaminophen has analgesic and antipyretic abilities, but does not produce an anti-inflammatory effect. Acetaminophen works by inhibiting the synthesis of prostaglandins in the central nervous system, not in the peripheral tissue.[6] Acetaminophen has a minimal effect on inhibiting prostaglandins and minimal anti-inflammatory capacities. Acetaminophen does not inhibit orthodontic tooth movement and is therefore a popular drug of choice for reducing orthodontic pain.[7]

Tea, from the plant *Camellia sinensis*, is consumed in different parts of the world as green, black, or Oolong tea. To produce green tea, freshly harvested leaves are immediately steamed to prevent fermentation, yielding a dry and stable product. This steaming process destroys the enzymes responsible for breaking down the colour pigments in the leaves and allows the tea to maintain its green colour during the subsequent rolling and drying processes. These processes preserve the natural micronutrients known as polyphenols, which have health-promoting properties.[8]

Green tea (*Camellia sinensis L.)* has been recommended to reduce orthodontic pain because it has anti-inflammatory and analgesic properties. Green tea also known as anti-diabetic, anti-mutagenic, anti-viral, and has anti-bacterial effect. Previous studies evidenced that green tea can reduce periodontal disease, dental caries, and the risk of having cardiovascular disease and neurode-generative disorders.[8,9,10] Green tea is rich in polyphenols and catechins, which act as antioxidants. Catechins contained in antioxidant flavonoids such as epicatechin, epicatechin 3-gallate (ECG), and epigallocatechin 3-gallate (EGCG) are the major polyphenolic compounds in green tea. The high concentration of epigallocatechin 3-gallate (EGCG) found in green tea has the ability to inhibit the effects of COX-2, the enzym that produce prostaglandin. This is the reason of anti-inflamatory effect in green tea.[11]

Other studies show that daily rinsing with green tea may be beneficial to control postoperative complications of impacted molar surgery, including pain. Green tea extract is said to effectively reduce postoperative pain because of its anti-inflammatory components.[12]

One study that compared the effectiveness of green tea mouthwash and chlorhexidine (CHX) mouthwash in controlling the pain and trismus associated with acute pericoronitis showed that green tea may be beneficial in controlling the signs and symptoms related to acute pericoronitis, including pain and mouth opening limitations.[13]

Gum chewing can also reduce orthodontic pain because the chewing movement stretches the periodontal ligament around the nerves and blood vessels, restoring blood circulation and lymphatic circulation in the periodontal ligament and thus preventing inflammation and edema, which will ultimately reduce pain.[3,14,15] When mild pressure is given, the pain felt by the patient may be reduced by repeated chewing (chewing sugarless gum or plastic wafers) for the first 8 hours after the orthodontic bracket is activated. Chewing gum works by temporarily shifting the teeth and allowing blood flow through the suppressed areas, thereby preventing the formation of

metabolic products that stimulate pain receptors. Chewing gum can reduce ischemia and inflammation in the periodontal ligament. Vascular stimulation and lymphatic circulation can prevent metabolic products that stimulate pain receptors and can accelerate the movement of teeth in the event of resorption undermining.[16] Studies comparing the effects of chewing gum and taking ibuprofen in managing pain due to the placement of fixed orthodontic appliance show that patients in the chewing gum group have lower pain scores.[3,15,17]

Studies show that chewing gum and gargling with green tea have minimal side effects and many other advantages. Therefore, it is important study whether chewing gum and gargling with green tea can replace taking acetaminophen in reducing orthodontic pain. The objective of this study is to determine whether there are differences between chewing gum, taking acetaminophen, and gargling green tea in reducing pain after fixed orthodontic appliance placement.

Material and Methods

This study was approved by the Ethics Committee of the Faculty of Dentistry Trisakti University. All participants signed an informed consent after receiving full explanations about the procedures. The sample calculation was obtained by preliminary study and minimum sample size was 10 subjects per group.[18] This study method was a quasi-experiment with controlled randomized post treatment approach using 40 subjects. The subjects were consecutively selected based on inclusion criteria and exclusion criteria. Afterwards, the subjects were randomly assigned into four equal groups: a group assigned to chewing gum, a group assigned to take acetaminophen, a group assigned to gargle green tea, and a control group.

The inclusion criteria required participant who were 18-40 years old and patients at the orthodontic clinic at Naval Dental Institute R.E. Martadinata. The exclusion criteria were any patients who have a history of temporo-mandibular joint (TMJ) disorders or drug allergy; any patients with a tooth problem that could potentially cause pain (such as caries media or irreversible pulpitis); and any patients who have liver problems. Additionally, participants in the chewing gum group were examined for TMJ abnormalities and subjects in the acetaminophen group were questioned about their history of liver disorders.

Subjects in all groups were subjected to the same orthodontic procedures and given the same bracket, wire, and elastomeric ties. Following that, the subjects were immediately provided with the treatment corresponding their assigned group. In the chewing gum group, the patients were asked to chew a sugar-free chewing gum (Spearmint; The Wrigley Company) for 10 minutes starting 2 hours after appliance placement and at 8-hour intervals afterwards for a week. In the acetaminophen group, the subjects took a 500-mg acetaminophen tablet starting 2 hours after appliance placement and at 8-hour intervals afterwards for a week. In the green tea group, the subjects took a sachet of 10-g green tea (Research Agency of Spices and Herbal Medicine, Ministry of Agriculture), mixed with 200 mL of hot water, gargle for 10 minutes starting 2 hours after appliance placement and at 8-hour intervals afterwards for a week. Subjects without treatment was considered as control group.

The pain was measured by a visual analogue scale (VAS). The VAS allows respondents to express their pain experience through a range of values from painless to very painful. VAS uses a horizontal line with a length of 100 mm, with a scale numbered 1-10 (0 indicating no pain and 10 indicating unbearable pain) and a word descriptor at each end. The respondents were asked to mark the number indicating the amount of pain experienced. The VAS value was determined by observing the number chosen by the respondent.[19]

The subjects were asked to complete a visual analog scale questionnaire at 2 hours and 6 hours after the appliance placement, at night before going to sleep on the day of appliance placement, 24 hours after appliance placement, and then daily at 8:00 PM each day after appliance placement for 7 days. After a week, the questionnaire was collected and analysed.

Statistical Analysis

Pain scores were calculated using descriptive statistics at each time point for each treatment group. General linear models were used to examine VAS pain

scores over time. This model was used to evaluate differences in treatment effects at specific time points. The Ryan Joiner test was used to determine the normality of the data. Since the distribution of the data was normal, a one-way ANOVA test was used to compare the reported pain among groups, and a Tukey HSD test was used to see difference between groups. Data were analysed using the Minitab statistical program for Windows 17.

Result

The result showed that the VAS scores of the chewing gum group and acetaminophen group were lower than the scores of green tea group and the control group. A General Linear Model test showed that different groups experienced statistically significant differences in reported pain levels ($p<0.05$) (Table 1).

Table 2 showed an increase in pain scores at 2 hours, 6 hours, and at the night after appliance placement. At 24 hours, there was a difference in the pain scores reported in the chewing gum group compared to the other three groups ($p<0.05$). The chewing gum group already experienced reduced pain at 24 hours after placement, while the other groups continued to report increases in pain, not experiencing a decrease in the pain until the second day.

A one-way ANOVA test showed significant differences in the pain levels reported by different groups ($F=40.80$; $p<0.05$). Multiple comparison Tukey HSD tests indicate that there was no significant difference ($p>0.05$) in the pain reported between the chewing gum and the acetaminophen groups. The amount of pain reported in the chewing gum and acetaminophen groups were significantly less than the amount of pain reported in the green tea and control groups ($p<0.05$).

Table 1. Result of General Linear Model: Pain versus treatment group and treatment time with crowding and anchorage as covariable

Source	DF	Seq SS	Adj SS	Adj MS	F	p
Group	3	408.208	408.208	136.069	40.80	0.000

Table 2. Pain level after fixed orthodontic appliance placement in four different experiment groups

Pain level per time	Groups			
	Chewing gum	Acetaminophen	Green tea	Control
2 hours	1.40 ± 1.51	1.20 ± 1.75	3.30 ± 2.98	3.20 ± 2.10
6 hours	2.90 ± 1.91	2.60 ± 2.76	4.50 ± 2.55	5.10 ± 2.38
At night	3.90 ± 2.13	2.80 ± 3.19	4.90 ± 2.33	5.40 ± 2.27
24 hours	3.00 ± 1.41	3.20 ± 2.15	5.50 ± 2.22	6.00 ± 2.79
Day-2	3.20 ± 1.48	2.90 ± 2.03	4.60 ± 2.41	5.00 ± 2.31
Day-3	2.30 ± 1.42	1.90 ± 1.52	4.00 ± 1.41	4.50 ± 2.07
Day-4	1.70 ± 1.16	1.20 ± 1.23	3.30 ± 1.83	4.10 ± 2.18
Day-5	0.70 ± 0.82	0.90 ± 1.20	2.30 ± 1.57	3.60 ± 2.01
Day-6	0.70 ± 0.82	0.60 ± 1.08	1.90 ± 1.45	3.10 ± 1.91
Day-7	0.40 ± 0.84	0.30 ± 0.48	1.30 ± 1.49	2.70 ± 1.77

Discussion

The Tukey HSD test results did not indicate a significant difference between the pain reported by the chewing gum and acetaminophen groups ($p>0.05$), which was consistent with the hypothesis and previous studies.[14,20,21] The pain scores at 24 hours after bracket placement in the chewing gum group was lower than the pain scores reported in the acetaminophen group. The results of this study indicate that there is an advantage to chewing gum compared to other modalities. These advantages include an earlier onset in reducing pain. Chewing gum relieves pain by temporarily moving the teeth and allowing blood flow through the suppressed areas, thereby preventing the formation of metabolic products that stimulate pain receptors.[16] Chewing gum after the orthodontic bracket placement can reduce ischemia and inflammation in the periodontal ligament. Vascular stimulation and lymphatic circulation can prevent the accumulation of metabolic products that stimulate pain receptors. [21]

There was a statistically significant difference in the amount of pain reported by the chewing gum/ acetaminophen groups and the green tea and control groups ($p<0.05$). Gargling green tea did not reduce pain as well as taking acetaminophen or chewing gum. Although the pain scores in the green tea group were lower than the pain scores in the control group, the differences were not statistically significant. Several studies have indicated that green tea has anti-inflammatory effects from the catechins.[12,13] Pain caused by the inflammation in the process of orthodontic treatment may be reduced by gargling green tea. However, no study has been able to identify this pain relief outcome in orthodontic treatments.

Green tea decreases pain by reducing inflammation of the gums caused by trauma to the periodontal tissues, as exhibited in previous studies that use green tea as a rinse after the third molar surgery.[12,13] In this study, green tea acts on compressed periodontal fibers from the mechanical loads, allowing continuous inflammation and prostaglandin expression in the long term which causes pain. This creates the difference in the amount of pain relief associated with green tea reported by post-operative patients and post-orthodontic bracket placement patients.[3]

Another study evaluated the effects of green tea on post-operative pain in tibia surgery. In this study, green tea was orally administrated to allow alpha waves generation, an electrical activity in the brain which responsible for relaxation. L-Theanine is an amino acid found in green tea, which can increase alpha waves activity in the brain. A patient's relaxation in the health-care setting could be a significant factor in alleviating post-surgical pain. However, the study showed that green tea was associated with diminishing post-operative anxiety, but not post-operative pain.[22]

Further study is required to determine whether using green tea as a mouthwash can be useful for reducing pain following orthodontic treatment. The appropriate dose and methods for use need to be explored further.

Conclusion

It can be concluded that there is no significant difference in the amount of pain reduction reported by patients who chewed gum and patients who took acetaminophen in after fixed orthodontic appliance placement. However, patients who gargled with green tea after orthodontic appliance placement experienced significantly less pain reduction. Chewing gum is found to be effective in reducing orthodontic pain and is also a safer alternative than consuming acetaminophen, as chewing gum does not have side effects. Chewing gum can also improve the flow of saliva in the mouth, hence it may enhance the remineralization process, which can reduce the formation of white spots and reduce plaque. Further research on the use of green tea in orthodontic treatment process is needed in order to investigate its effectiveness. In daily orthodontic practice, the patient may be advised to chew gum to reduce pain after fixed orthodontic appliance placement with limited risk of side effects.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

References

1. Patel S, McGorray SP, Yezierski R, Fillingim R, Logan H, Wheeler TT. Effects of analgesics on orthodontic pain. Am J Orthod Dentofacial Orthop. 2011;139(1):153-58. DOI:10.1016/j.ajodo.2010.07.017
2. Abdelrahman RS, Al-Nimri KS, Al Maaitah EF. Pain experience during initial alignment with three types of nickel-titanium archwires: A prospective clinical trial. Angle Orthod. 2015;85(6):1021-6. DOI: 10.2319/071614-498.1.
3. Mishra R, Goswami Y, Quadri SM, Sindgi F. Orthodontic Pain-Blessing with Disguise. J Dent Med Sci. 2015;14(4): 82-87. DOI: 10.9790/0853-14468287
4. Krishnan V. Orthodontic pain: from causes to management - a review. Eur J Orthod. 2007; 29 (2):170-9. DOI: 10.1093/ejo/cjl081
5. Rakhshan H, Rakhshan V. Pain and discomfort perceived during the initial stage of active fixed orthodontic treatment. Saudi Dent J. 2015; 27(2): 81-87. DOI: 10.1016/j.sdentj.2014.11.002
6. Kehoe MJ, Cohen SM, Zarrinnia K, Cowan A. The effect of acetaminophen, ibuprofen, and misoprostol on prostaglandin E2 synthesis and the degree and rate of orthodontic tooth movement. Angle Orthod. 1996; 66 (5):339-50. DOI: 10.1043/0003-3219(1996)066<0339:TEOAIA>2.3.CO;2
7. Salmassian R, Oesterle LJ, Shellhart WC, Newman SM. Comparison of the efficacy of ibuprofen and acetaminophen in controlling pain after orthodontic tooth movement. Am J Orthod Dentofac Orthop. 2009;135(4):516-21. DOI: 10.1016/j.ajodo.2007.05.020
8. Chacko SM, Thambi PT, Kuttan R, Nishigaki I. Beneficial effects of green tea: A literature review. Chin Med. 2010; 5: 13. DOI: 10.1186/1749-8546-5-13.
9. Maroon JC, Bost JW, Maroon A. Natural anti-inflammatory agents for pain relief. Surg Neurol Int. 2010;1. DOI: 10.4103/2152-7806.73804.
10. Badan Pengawas Obat dan Makanan RI. Acuan Sediaan Herbal Volume 5. Ed ke-1. Jakarta: Direktorat OAI, Deputi II, Badan POM RI. 2010. Pg. 39-41.
11. Kim HR, Rajaiah R, Wu Q-L, Satpute SR, Tan MT, Simon JE, et al. Green tea protects rats against autoimmune arthritis by modulating disease-related immune events. J Nutr. 2008; 138(11):2111-6. DOI: 10.3945/jn.108.089912.
12. Eshghpour M, Mortazavi H, Mohammadzadeh Rezaei N, Nejat A. Effectiveness of green tea mouthwash in postoperative pain control following surgical removal of impacted third molars: double blind randomized clinical trial. Daru. 2013; 21(1):59. DOI: 10.1186/2008-2231-21-59.
13. Shahakbari R, Eshghpour M, Rajaei A, Rezaei N, Golfakhrabadi P, Nejat A. Effectiveness of green tea mouthwash in comparison to chlorhexidine mouthwash in patients with acute pericoronitis: a randomized clinical trial. Int J Oral Maxillofac Surg. 2014;43(11):1394-8. DOI: 10.1016/j.ijom.2014.05.017
14. Murdock S, Phillips C, Khondker Z, Hershey HG. Treatment of pain after initial archwire placement: a noninferiority randomized clinical trial comparing over-the-counter analgesics and bite-wafer use. Am J Orthod Dentofac Orthop.2010; 137(3):316-23. DOI: 10.1016/j.ajodo.2008.12.021
15. Shedam M, Kalia A, Hedge A, Mehta K. Effect of chewing gum on the pain associated with initial placement of fixed orthodontic appliances. J Dent&Oral Care. 2015; 1:1-5. DOI: http://www.dx.doi.org/10.15436/2379-1705.15.002
16. Proffit WR, Fields Jr HW, Sarver DM. Contemporary orthodontics. Ed ke-4. St. Louis: Mosby; 2014. Pg. 289-293, 302-303.
17. Ireland A., dkk. Comparative Assesement of chewing gum and ibuprofen in the management of orthodontic pain with fixed appliance: a pragmatic multicenter randomized controlled trial. Am J Orthod Dentofacial Orthop. 2016; 150(2): 220-227. DOI: 10.1016/j.ajodo.2016.02.018
18. Lwangga SK, Lemeshow S. Sample size determination in health studies: a practical manual. Geneva: WHO. 1991.
19. Mangnall LA, Dietrich T, Scholey JM. A randomized controlled trial to assess the pain associated with the debond of orthodontic fixed appliances. J Orthod. 2013; 40(3):188-96. DOI: 10.1179/1465313313Y.0000000045
20. Farzanegan F, Zebarjad SM, Alizadeh S, Ahrari F. Pain reduction after initial archwire placement in orthodontic patients: a randomized clinical trial. Am J

Orthod Dentofac Orthop. 2012;141(2):169-73. DOI: 10.1016/j.ajodo.2011.06.042.

21. Benson P, Razi R, Al-Bloushi R. The effect of chewing gum on the impact, pain and breakages associated with fixed orthodontic appliances: a randomized clinical trial. Orthod Craniofac Res. 2012; 15(3):178-87. DOI: 10.1111/j.1601-6343.2012.01546.x
22. Nabi BN, Saberi A, Hashemi M, et al. The Effects of Green Tea on Post-Operative Pain and Anxiety in Tibia Surgery: A Randomized Double Blind Clinical Trial. Int J Med Res Health Sci. 2016, 5(7S):576-583.